

MM54C89/MM74C89 64-Bit TRI-STATE® Random Access Read/Write Memory

General Description

The MM54C89/MM74C89 is a 16-word by 4-bit random access read/write memory. Inputs to the memory consist of four address lines, four data input lines, a write enable line and a memory enable line. The four binary address inputs are decoded internally to select each of the 16 possible word locations. An internal address register latches the address information on the positive to negative transition of the memory enable input. The four TRI-STATE data output lines working in conjunction with the memory enable input provide for easy memory expansion.

Address Operation: Address inputs must be stable t_{SA} prior to the positive to negative transition of memory enable. It is thus not necessary to hold address information stable for more than t_{HA} after the memory is enabled (positive to negative transition of memory enable).

Note: The timing is different than the DM7489 in that a positive to negative transition of the memory enable must occur for the memory to be selected.

Write Operation: Information present at the data inputs is written into the memory at the selected address by bringing write enable and memory enable low.

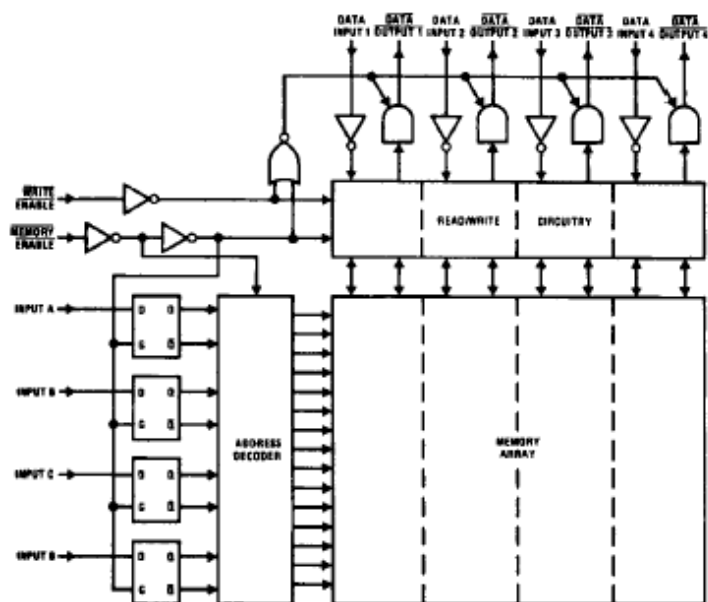
Read Operation: The complement of the information which was written into the memory is non-destructively read out at the four outputs. This is accomplished by selecting the desired address and bringing memory enable low and write enable high.

When the device is writing or disabled the output assumes a TRI-STATE (Hi-z) condition.

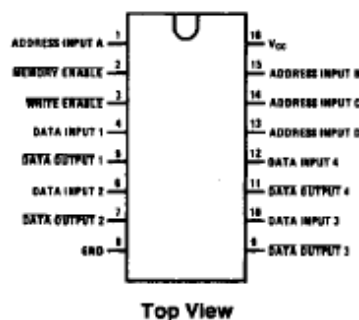
Features

- Wide supply voltage range 3.0V to 15V
- Guaranteed noise margin 1.0V
- High noise immunity 0.45 V_{CC} (typ.)
- Low power fan out of 2 driving 74L
- Low power consumption 100 nW/package (typ.)
- Fast access time 130 ns (typ.) at V_{CC} = 10V
- TRI-STATE output

Logic and Connection Diagrams



Dual-In-Line Package



*For complete Rochester ordering guide, please refer to page 2
Please consult factory for specific package availability*

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Rochester Ordering Guide

Rochester Part Number	National Semiconductor Part Number	Package	Temperature
MM54C89J	MM54C89J	CDIP-16	-55° to +125°C
MM54C89J/B	MM54C89J/883	CDIP-16	-55° to +125°C
MM54C89W	MM54C89W	SOP-16, Ceramic	-55° to +125°C
MM54C89W/B	MM54C89W/883	SOP-16, Ceramic	-55° to +125°C
MM54C89D	MM54C89D	CDIP-16	-55° to +125°C
MM54C89D/B	MM54C89D/883	CDIP-16	-55° to +125°C
MM54C89F	MM54C89F	FP-16, Ceramic	-55° to +125°C
MM74C89J	MM74C89J	CDIP-16	-40° to +85°C
MM74C89N	MM74C89N	PDIP-16	-40° to +85°C

Absolute Maximum Ratings (Note 1)

Voltage at any Pin	-0.3V to $V_{CC} + 0.3V$	Power Dissipation (P_D)	
Operating Temperature Range		Dual-In-Line	700 mW
MM54C89	-55°C to +125°C	Small Outline	500 mW
MM74C89	-40°C to +85°C	Operating V_{CC} Range	3.0V to 15V
Storage Temperature Range (T_S)	-65°C to +150°C	Absolute Maximum V_{CC}	18V
		Lead Temperature (T_L)	
		(Soldering, 10 seconds)	260°C

DC Electrical Characteristics Min/Max limits apply across temperature range, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CMOS TO CMOS						
$V_{IN(1)}$	Logical "1" Input Voltage	$V_{CC} = 5.0V$ $V_{CC} = 10V$	3.5 8.0			V V
$V_{IN(0)}$	Logical "0" Input Voltage	$V_{CC} = 5.0V$ $V_{CC} = 10V$			1.5 2.0	V V
$V_{OUT(1)}$	Logical "1" Output Voltage	$V_{CC} = 5.0V, I_O = -10 \mu A$ $V_{CC} = 10V, I_O = -10 \mu A$	4.5 9.0			V V
$V_{OUT(0)}$	Logical "0" Output Voltage	$V_{CC} = 5.0V, I_O = +10 \mu A$ $V_{CC} = 10V, I_O = +10 \mu A$			0.5 1.0	V V
$I_{IN(1)}$	Logical "1" Input Current	$V_{CC} = 15V, V_{IN} = 15V$		-0.005	1.0	μA
$I_{IN(0)}$	Logical "0" Input Current	$V_{CC} = 15V, V_{IN} = 0V$	-1.0	-0.005		μA
I_{OZ}	Output Current in High Impedance State	$V_{CC} = 15V, V = 15V$ $V_{CC} = 15V, V_O = 0V$	-1.0	0.005 -0.005	1.0	μA μA
I_{CC}	Supply Current	$V_{CC} = 15V$		0.05	300	μA
CMOS/LPTTL INTERFACE						
$V_{IN(1)}$	Logical "1" Input Voltage	54C, $V_{CC} = 4.5V$ 74C, $V_{CC} = 4.75V$	$V_{CC} - 1.5$ $V_{CC} - 1.5$			V V
$V_{IN(0)}$	Logical "0" Input Voltage	54C, $V_{CC} = 4.5V$ 74C, $V_{CC} = 4.75V$			0.8 0.8	V V
$V_{OUT(1)}$	Logical "1" Output Voltage	54C, $V_{CC} = 4.5V, I_O = -360 \mu A$ 74C, $V_{CC} = 4.75V, I_O = -360 \mu A$	2.4 2.4			V V
$V_{OUT(0)}$	Logical "0" Output Voltage	54C, $V_{CC} = 4.5V, I_O = +360 \mu A$ 74C, $V_{CC} = 4.75V, I_O = +360 \mu A$			0.4 0.4	V V
OUTPUT DRIVE (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)						
I_{SOURCE}	Output Source Current (P-Channel)	$V_{CC} = 5.0V, V_{OUT} = 0V$ $T_A = 25^\circ C$	-1.75	-3.3		mA
I_{SOURCE}	Output Source Current (P-Channel)	$V_{CC} = 10V, V_{OUT} = 0V$ $T_A = 25^\circ C$	-8.0	-15		mA
I_{SINK}	Output Sink Current (N-Channel)	$V_{CC} = 5.0V, V_{OUT} = V_{CC}$ $T_A = 25^\circ C$	1.75	3.6		mA
I_{SINK}	Output Sink Current (N-Channel)	$V_{CC} = 10V, V_{OUT} = V_{CC}$ $T_A = 25^\circ C$	8.0	16		mA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

AC Electrical Characteristics* $T_A = 25^\circ C, C_L = 50 pF$, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd}	Propagation Delay from Memory Enable	$V_{CC} = 5V$ $V_{CC} = 10V$		270 100	500 220	ns ns
t_{ACC}	Access Time from Address Input	$V_{CC} = 5V$ $V_{CC} = 10V$		350 130	650 280	ns ns
t_{SA}	Address Setup Time	$V_{CC} = 5V$ $V_{CC} = 10V$	150 60			ns ns
t_{HA}	Address Hold Time	$V_{CC} = 5V$ $V_{CC} = 10V$	60 40			ns ns
t_{ME}	Memory Enable Pulse Width	$V_{CC} = 5V$ $V_{CC} = 10V$	400 150	250 90		ns ns

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AC Electrical Characteristics* $T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, unless otherwise noted (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{SR}	Write Enable Setup Time for a Read	$V_{CC} = 5\text{V}$	0			ns
		$V_{CC} = 10\text{V}$	0			ns
t_{WS}	Write Enable Setup Time for a Write	$V_{CC} = 5\text{V}$			t_{ME}	ns
		$V_{CC} = 10\text{V}$			t_{ME}	ns
t_{WE}	Write Enable Pulse Width	$V_{CC} = 5\text{V}$, $t_{WS} = 0$	300	160		ns
		$V_{CC} = 10\text{V}$, $t_{WS} = 0$	100	60		ns
t_{HD}	Data Input Hold Time	$V_{CC} = 5\text{V}$	50			ns
		$V_{CC} = 10\text{V}$	25			ns
t_{SD}	Data Input Setup	$V_{CC} = 5\text{V}$	50			ns
		$V_{CC} = 10\text{V}$	25			ns
t_{1H} , t_{0H}	Propagation Delay from a Logical "1" or Logical "0" to the High Impedance State from Memory Enable	$V_{CC} = 5\text{V}$, $C_L = 5\text{ pF}$, $R_L = 10\text{ k}$		180	300	ns
		$V_{CC} = 10\text{V}$, $C_L = 5\text{ pF}$, $R_L = 10\text{ k}$		-85	120	ns
t_{1H} , t_{0H}	Propagation Delay from a Logical "1" or Logical "0" to the High Impedance State from Write Enable	$V_{CC} = 5\text{V}$, $C_L = 5\text{ pF}$, $R_L = 10\text{ k}$		180	300	ns
		$V_{CC} = 10\text{V}$, $C_L = 5\text{ pF}$, $R_L = 10\text{ k}$		85	120	ns
C_{IN}	Input Capacity	Any Input (Note 2)		5		pF
C_{OUT}	Output Capacity	Any Output (Note 2)		6.5		pF
C_{PD}	Power Dissipation Capacity	(Note 3)		230		pF

*AC Parameters are guaranteed by DC correlated testing.

Note 2: Capacitance is guaranteed by periodic testing.

Note 3: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics application note, AN-90.

AC Electrical Characteristics* Guaranteed across the specified temperature range, $C_L = 50\text{ pF}$

Parameter	Conditions	MM54C89		MM74C89		Units
		$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		
		Min	Max	Min	Max	
t_{PD}	$V_{CC} = 5\text{V}$		700		600	ns
	$V_{CC} = 10\text{V}$		310		265	ns
	$V_{CC} = 15\text{V}$		250		210	ns
t_{ACC}	$V_{CC} = 5\text{V}$		910		780	ns
	$V_{CC} = 10\text{V}$		400		345	ns
	$V_{CC} = 15\text{V}$		320		270	ns
t_{SA}	$V_{CC} = 5\text{V}$	210		180		ns
	$V_{CC} = 10\text{V}$	90		80		ns
	$V_{CC} = 15\text{V}$	70		60		ns
t_{HA}	$V_{CC} = 5\text{V}$	80		70		ns
	$V_{CC} = 10\text{V}$	55		50		ns
	$V_{CC} = 15\text{V}$	45		40		ns
t_{ME}	$V_{CC} = 5\text{V}$	560		480		ns
	$V_{CC} = 10\text{V}$	210		180		ns
	$V_{CC} = 15\text{V}$	170		150		ns
t_{WE}	$V_{CC} = 5\text{V}$	420		360		ns
	$V_{CC} = 10\text{V}$	140		120		ns
	$V_{CC} = 15\text{V}$	110		100		ns
t_{HD}	$V_{CC} = 5\text{V}$	70		60		ns
	$V_{CC} = 10\text{V}$	35		30		ns
	$V_{CC} = 15\text{V}$	30		25		ns

*AC Parameters are guaranteed by DC correlated testing.

AC Electrical Characteristics*

Guaranteed across the specified temperature range, $C_L = 50 \text{ pF}$ (Continued)

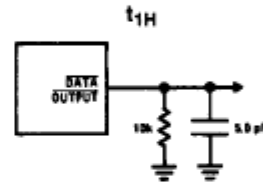
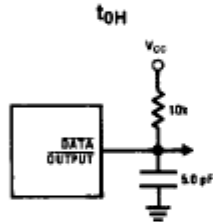
Parameter	Conditions	MM54C89 $T_A = -55^\circ\text{C to } +125^\circ\text{C}$		MM74C89 $T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Units
		Min	Max	Min	Max	
t_{SD}	$V_{CC} = 5\text{V}$	70		60		ns
	$V_{CC} = 10\text{V}$	35		30		ns
	$V_{CC} = 15\text{V}$	30		25		ns
t_{1H}, t_{0H}	$V_{CC} = 5\text{V}$		420		360	ns
	$V_{CC} = 10\text{V}, C_L = 5 \text{ pF}$		170		145	ns
	$V_{CC} = 15\text{V}, R_L = 10 \text{ k}\Omega$		135		115	ns

*AC Parameters are guaranteed by DC correlated testing.

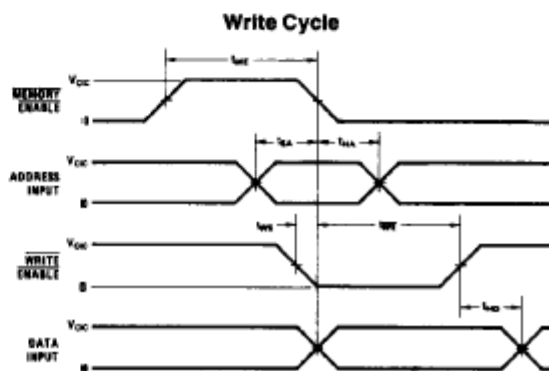
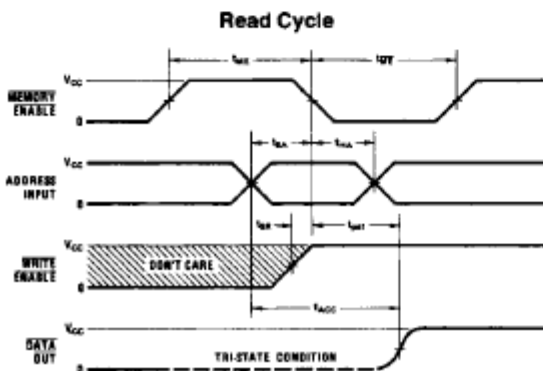
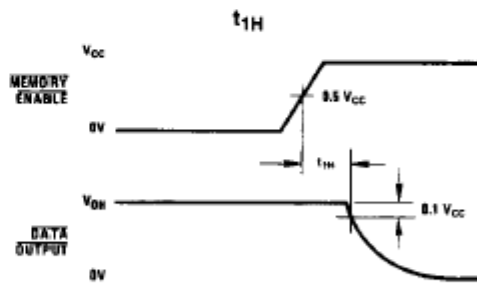
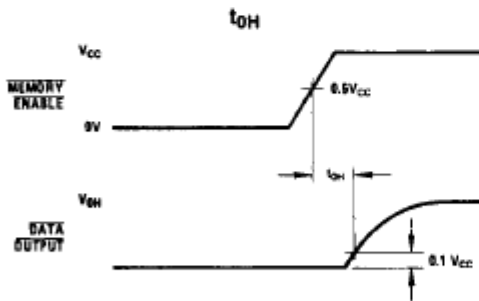
Truth Table

ME	WE	Operation	Condition of Outputs
L	L	Write	TRI-STATE
L	H	Read	Complement of Selected Word
H	L	Inhibit, Storage	TRI-STATE
H	H	Inhibit, Storage	TRI-STATE

AC Test Circuits

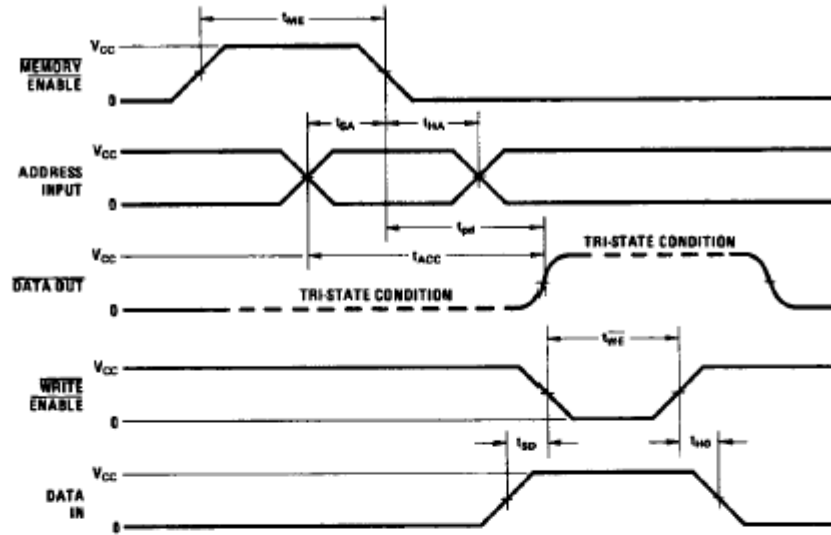


Switching Time Waveforms



Switching Time Waveforms (Continued)

Read Modify Write Cycle



Note: $t_r = 60$ ns
 $t_f = 10$ ns

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